Appendix 4B: Terrestrial Impact Analysis Methods

4.B Terrestrial Impact Analysis Methods

4.B.1 Introduction

This section presents the qualitative and quantitative methods used to analyze the effects of the proposed project (PP) on state-listed wildlife and plant species (also called terrestrial species, to distinguish them from fish species) in the project area.

4.B.1.1 Spatial Extent of the Effects Analysis

The take analysis for wildlife and plant species is primarily confined to the legal Delta. Construction of the water conveyance facility, geotechnical exploration activities, and transmission line construction will be confined primarily to the legal Delta, although a portion of the transmission line alignment extends east beyond the legal Delta boundary. For a full description of the Project Area, of which the legal Delta is a part, see Chapter 1 *Introduction*. For a full description of the water conveyance construction spatial footprint, see Chapter 3 *Project Description*.

Habitat restoration to offset the effects of the PP on listed species will primarily occur within the legal Delta. Take of listed species that could result from restoration will not be covered under this 2081.

4.B.1.2 Temporal Extent of the Wildlife and Plant Effects Analysis

Construction of the water conveyance facility and the annual tracking of effects will last for 14 years; activities included in the PP also include start-up of the new facilities (assumed to be 1 year) and tracking of their operations for another 10 years, thus the temporal extent of activities evaluated lasts for 25 years. Construction of all habitat restoration is expected to have been completed within two years of construction completion. Monitoring and maintenance of restored and protected habitat will continue in perpetuity.

4.B.1.3 Methods for Quantitative Impact Assessment

4.B.1.3.1 Take Analysis

Implementation of the PP will result in incidental take of listed species. The following types of effects will result from the PP.

- Permanent habitat loss or conversion
- Temporary habitat loss
- Construction-related injury or mortality
- Capturing individuals to re-locate them out of harm's way
- Effects extending beyond the project footprint or later in time such as exhaust, dust, light, noise, and vibration

The effects of construction of the water conveyance facilities can be assessed on the basis of a known maximum disturbance footprint.

The estimates of suitable habitat loss presented in Chapter 4 *Take Analysis* represent the most conservative estimate of the take and the impact of the taking. The Applicant will track actual effects during implementation to ensure effects do not exceed allowable levels. Once maximum take limits are reached, no further take is permitted without amendment/modification of the incidental take permit.

4.B.1.3.1.1 Habitat Models

Habitat models bring together information about environmental attributes, species life history, and environmental requirements to create a spatially explicit model of suitable habitat at a regional scale. Habitat models collect a variety of information relating to habitat requirements to create hypotheses of species-habitat relationships rather than statements of proven cause and effect relationships (Schamberger et al. 1982). Habitat models for wildlife species were formulated primarily using vegetation data from existing GIS data sources as described in BDCP Appendix 2.A, *Covered Species Accounts*, Section 2.A.0.1.7, *Species Habitat Suitability Model Methods* (California Department of Water Resources 2013).

4.B.1.3.1.2 Mason's Lilaeopsis

The analysis of effects on Mason's lilaeopsis was not based on a habitat suitability model, but on site specific habitat assessments.

Within the project area, this species' primary habitat is tidally inundated bare areas of clay or clay loam substrate that are located on the outer margin of wave-cut beaches, or eroding earthen levees, or on the flats immediately below wave-cut beaches and eroding levees (Witham and Kareofelas 1994; Zebell and Fiedler 1996). In an effort to determine potential impacts to Mason's lilaeopsis or its suitable habitat, surveys were conducted at sites where the PP footprint intersects with intertidal habitat. These sites are potential locations for intakes, intake work areas, barge landings, a forebay overflow structure, and the HOR gate. The survey protocol was determined by information on the plant's phenology, reproduction, habitat requirements, and plant associates (*Lilaeopsis masonii* Survey Protocol, 2016).

4.B.1.3.2 Analysis of Impacts by Type of Effect

Potential adverse effects on each species were assessed in each of three categories:

- permanent habitat loss and fragmentation;
- construction related effects; and
- operation and maintenance.

4.B.1.3.2.1 Habitat Loss and Fragmentation

This effect category includes permanent habitat loss and fragmentation as a result of development-related activities (e.g., water conveyance construction). For the water conveyance facility, habitat loss and conversion was assessed quantitatively by overlaying GIS data layers that represent the actual geographic footprint of the PP with GIS data layers for species habitat

models. For transmission line construction, a 50-foot wide geographic footprint represented in GIS data layers was used to estimate a conservative suitable habitat take limit.

Habitat fragmentation was assessed qualitatively based on an evaluation of the proposed project in relation to modeled species habitat, and evaluation of the quality of habitat affected. The effects analysis recognizes that the quality of modeled species habitat, in terms of long-term conservation value and ability to sustain listed species populations, varies throughout the Project Area. The quality of species habitat lost or converted as a result of the PP was assessed using available, existing information. Information used to assess the quality of affected habitat included patch size and fragmentation of modeled habitat, adjacent land uses such as roads and other development based on aerial imagery, information from literature and species experts related to species distribution in the Project Area, species occurrence data, and proximity to existing protected lands.

Species occurrence data were evaluated as a component of the quality assessment for habitat permanently lost or converted. For most listed species, occurrence data is incomplete and therefore has limited utility for assessing the extent to which modeled habitat is occupied or determining where the greatest population effects will occur. However, DWR has conducted field surveys recently in and around the conveyance facility footprint and alternative alignments for this facility (see Species Accounts, Chapter 2). Therefore, occurrence data are used to assess effects of the conveyance facility construction more than they are used to assess effects of other aspects of the PP.

4.B.1.3.2.2 Construction Related Effects

Construction related effects include the effects that would result from construction activities. This includes injury or mortality that may result from construction equipment, and temporary habitat disturbance that may result from overland travel of construction equipment. This also includes effects of noise, vibration, and lighting that may occur outside the construction footprint and effect species in adjacent habitat. All these effects were assessed qualitatively, except for potential vibration effects on California tiger salamander and giant garter snake. For these two species, vibration effects were assessed quantitatively, assuming vibrations could reach a distance of 50 feet from the construction footprint.

4.B.1.3.2.3 Operation and Maintenance

Operation and maintenance effects are those effects that would result from operation and maintenance of the constructed facilities. These include effects from factors such as lighting of facilities, use of heavy equipment, vehicle access to sites, or vegetation maintenance. These effects were analyzed qualitatively for each species, and each activity type.

4.B.1.3.3 Analysis of Effects by Activity Type

The following provides a description of how habitat loss effects were analyzed for each activity type.

4.B.1.3.3.1 Activity Types with Fixed GIS Footprints

Activity types with fixed GIS footprints include tunneled conveyance facilities, Clifton Court Forebay modifications, the HOR gate, and disposition of reusable tunnel material. For these

activity types, habitat loss was estimated by overlaying construction footprints on habitat models, with the exception of Mason's lilaeopsis as described in Section 4.B.4.1.1.2, *Mason's Lilaeopsis*.

4.B.1.3.3.2 Geotechnical Exploration

For geotechnical exploration activities, a geographic footprint represented in GIS data layers was used to conservatively estimate the area potentially disturbed by exploration activities. Geotechnical exploration was not analyzed under the category of habitat loss because most of the disturbance will consist of driving overland, primarily over grasslands and agricultural lands, to access exploration sites. Disturbance may last several hours to 12 days depending on location, and was treated under construction-related effects as temporary habitat disturbance and potential mortality resulting from crushing individuals during overland travel. The actual permanent disturbance consists of a series of widely spaced holes, each approximately 8 inches in diameter, which will be grouted. Therefore the effect is primarily potential injury, harassment, or mortality for some species, and limited, very temporary habitat disturbance. Although the area of disturbance was quantified for each species, the types of effects were described qualitatively.

A geographic footprint represented in GIS data layers was used to conservatively estimate the area potentially disturbed by geotechnical exploration activities. This footprint consisted of a series of points along the conveyance alignment that were selected based on an assessment of the needs for more detailed geotechnical information. DWR estimates that 1,497 geotechnical exploration sites will be needed to analyze conditions prior to construction. Some of these points fall within areas of proposed conveyance facility construction and others are situated above the proposed tunnels. Based on DWR's experience with these type of activities and some preliminary field estimates, it is expected that the geotechnical exploration sites will result in approximately 0.84 acre of disturbance per site, which includes a 0.23 acre (10,000 square feet) area of temporary disturbance for drilling and staging plus an additional 0.61 acres of temporary disturbance associated with accessing the sites, which will consist of overland travel in agricultural areas and grasslands, which could result in temporary disturbance to vegetation. Figure 4.B-1 shows a typical geotechnical exploration work site. For the analysis, the geotechnical exploration sites, which are represented by points in GIS, were overlain on the conveyance footprint and intersected with the surface footprints and subsurface footprints to establish geotechnical exploration zones (GEZ). Not all surface features were included as part of the surface GEZ because they had not been identified as potential geotechnical exploration sites (i.e., these areas did not have geotechnical exploration site GIS point data within in them). The resulting surface GEZ is 5,980 acres with 913 geotechnical exploration sites and the subsurface GEZ is 1,531 acres with 392 geotechnical exploration sites. This analysis also showed that of the 1,497 geotechnical sites identified only 1,305 represent unique locations (i.e., 192 sites overlapped with at least one other site). The temporary impacts associated with geotechnical explorations within the surface GEZ will be 767 acres (0.84 acre x 913 sites) and within the subsurface GEZ will be 329 acres (0.84 acre x 392 sites). Because the exact locations of these impacts are yet to be determined, estimates were generated by applying the proportion of these impact acreages within the GEZ to the know acreage of modeled habitat within each GEZ. For the surface GEZ, 13% of the area will be temporarily affected (767 acres of impact/ 5,980 acres of surface GEZ) and for the subsurface GEZ 22% of the area will be temporarily affected (329 acres of impact/1,531 acres of subsurface GEZ).

Figure 4.B-1. Example of a Typical Geotechnical Exploration Site

4.B.1.3.3.3 Safe Haven Work Areas

All activities related to safe haven work areas will be required to avoid listed species habitat, therefore it was assumed that safe haven work areas will not affected the listed species, with the exception of foraging habitat for Swainson's hawk and tricolored blackbird. For these species, it was assumed that all safe haven work areas would consist of habitat for these species. Assuming each of 134 pressurized sites will consist of 0.5 acre of impact, each of 22 atmospheric sites will consist of 3.0 acres of impact, and access roads will affect up to 0.6 acre per site, an estimated 227 acres of foraging habitat will be affected for each species.

4.B.1.3.3.4 Power Supply and Grid Connections

Construction of transmission lines will result primarily in temporary impacts from overland travel and equipment staging by construction and installation vehicles (Table 4.B-1). It was assumed that for each species, no more than one acre of the habitat loss would consist of permanent effects (poles, towers), and the rest of the effect would result from overland travel, construction, and vegetation maintenance. The acre of permanent effect is a conservative estimate: the only permanent effect will be from the approximate 1 foot by 1 foot footprint of the poles and will result in a total of 0.1 acres (Table 4.B-1). The temporary effects from overland travel and staging are not expected to result in ground disturbance such that restoration would be needed. In order to provide an estimate of the temporary habitat loss from pole placement, line stringing and equipment and vehicle staging, a 50-foot wide corridors around the preliminary transmission line alignments were established in GIS and used to intersect the modeled habitat for each listed species. This provides a conservative estimate of the temporary species habitat loss, a premise that was validated by comparing the total acreage resulting from this GIS analysis to the construction details presented in Chapter 3. Table 4.B-1 below summarizes this comparison. As seen in this table, the total footprint from the GIS analysis is twice the amount of impact as that described under the preliminary construction details. However, it is unlikely the temporary impacts will double as a result. Therefore, the transmission line temporary impact estimate provided for this analysis more than covers what the actual, temporary habitat loss will likely be.

Table 4.B-1. Assumptions for Transmission Line Effect Analysis

Transmission Line Size	69 kV	230 kV	TOTAL
Preliminary Construction Details			
Permanent Footprint Size for Pole and Tower Construction (Square feet)	6	30	NA
Temporary Footprint Size for Pole and Tower Construction (Square feet)	5,000	5,000	NA
Temporary Access Route Widths (feet)	12	12	NA
Number of Miles of Line (Permanent)[1]	0	17	NA
Number of Miles of Line (Temporary)[1]	6	30	NA
Total Number of Poles (Permanent)[2]	-	121	NA
Total Number of Poles (Temporary)[2]	71	211	NA
Impacts Based On Preliminary Construction Details			
Permanent Impacts for Permanent Pole/Tower Footings (square feet)	-	3,622	3,622
Total Permanent Impacts for Permanent Poles/Towers Footings (acres)	-	*0.08*	*0.1*
Temporary Impact from Access Routes for Permanent Lines (acres)	-	25	25
Temporary Impact from Access Routes for Temporary Lines (acres)	9	44	52

Transmission Line Size	69 kV	230 kV	TOTAL
Temporary Impacts from Temporary Pole/Tower Footings (square feet)	428	6,336	6,764
Temporary Impacts for Temporary Poles/Towers Footings (acres)	0.01	0.15	0.2
Number of current turns deviating by more than 15 degrees and/or 2 miles - Permanent Lines[3]	0	11	NA
Number of current turns deviating by more than 15 degrees/and or 2 miles - Temporary Lines[3]	12	23	NA
Each Conductoring Area Size (square feet)	35,000	35,000	NA
Temporary Conductoring Impact for Permanent Lines (acres)	0	9	9
Temporary Conductoring Impact for Temporary Lines (acres)	10	18	28
Temporary Impacts for Permanent Pole/Tower Work Areas (Square Feet)	-	603,680	603,680
Temporary Impacts for Permanent Pole/Tower Work Areas (acres)	-	13.86	14
Temporary Impacts for Temporary Pole/Tower Work Areas (Square Feet)	35,7121	1,062,336	1,419,457
Temporary Impacts for Temporary Pole/Tower Work Areas (acres)	8	24	33
Total Temporary Impacts for Permanent Transmission Lines (acres)	0	48	48
Total Temporary Impacts for Temporary Transmission Lines (acres)	27	87	113
Total Temporary Impacts for Transmission Lines (acres)	*27*	*134*	*161*
Total Impacts for Transmission Lines (temporary) (acres)	*27*	*134*	*161*
Impacts Based on GIS Analysis			
Total Estimated Temporary Impacts from Permanent Lines Assuming a 50-foot Corridor Width (acres)	-	104	104
Total Estimated Temporary Impacts from Temporary Lines Assuming a 50-foot Corridor Width (acres)	37	182	219
Total Estimated Temporary Impacts (acres)	*37*	*286*	*323*

[a] The 230 kV estimate includes some miles of 500 kV and 230/34.5 kV. Effects from the construction of permanent and temporary lines are considered permanent because the effect will persist for more than one year.

[b] Assumes a pole/tower every 450 feet for 69 KV lines, and every 750 feet for 230 kV lines. Effects from the construction of permanent and temporary lines are considered permanent because the effect will persist for more than one year.

[C] The number of conductoring areas was determined by following the transmission alignments on the maps and noting every 2 miles and/or deviations greater than 15 degrees (this was visually estimated and essentially captures all slight and sharp turns in the lines).

4.B.1.3.4 Swainson's Hawk Analysis of Affected Nest Sites

For the purpose of estimating the loss of Swainson's hawk nest sites as a result of intake construction, DWR defined an *affected nest site* as a 125-acre area where more than 50% of the suitable nest trees (20 feet or taller) will be removed. 125-acre areas were used based on Swainson's hawk nests normally being spaced approximately 0.5 mile apart (Bradbury pers. com. February 24, 2016). This analysis is considered to be conservative as the size of nesting territory with a 0.5-mile radius (centered on the nest) would be a little over 500 acres.

A grid of 125-acre blocks was placed over each component of project footprint in which trees are to be removed (Figure 4.7-39). The grid was overlain in a manner that placed the most complete squares of the grid in the project footprint (i.e., the grid was adjusted so that, to the extent possible, entire squares rather than portions of squares overlapped with the project footprint).

4.B.1.3.5 Jeopardy Analysis

For each species, a determination was made as to whether the net effects on the species will result in full mitigation of the proposed project effects on the species, and will thereby avoid jeopardizing the continued existence of that species. This determination was guided by the proportion of a species' range and life cycle within the Project Area and the level of effect on that species. For example, all else being equal, the potential to jeopardize a species that has a small portion of its range in the Project Area is less than the potential to jeopardize a species that has a large portion of its range in the Project Area.

Table 4.B-1.Take Analysis Methods and Assumptions for Water Conveyance Facility Construction.

Activity/Impact Mechanism	**Method of Impact Estimation**	**Key Assumptions for Purposes of Analysis**
Water Conveyance Facility Construction		
Conveyance facilities construction/ permanent removal of habitat	• GIS layer for construction footprint was overlain on modeled habitat and critical habitat GIS layers.	• Construction of the forebay, intakes, permanent access roads, shafts, Clifton Court expansion area result in permanent removal of habitat within construction footprint.
Reusable tunnel material/ permanent removal of habitat	• GIS layer for footprint of reusable tunnel material areas was overlain on modeled habitat and critical habitat GIS layers. • Where take minimization measures require avoidance of species habitat, this requirement was factored into the impact estimation for species.	• For the purposes of impact analysis, it is assumed reusable tunnel material areas will not be returned to pre-project conditions.
Conveyance facilities/ Potential Temporary Activities	• GIS layer for footprint of staging areas, intake pipelines, and barge unloading facilities was overlain on modeled habitat and critical habitat GIS layers.	• Staging areas, intake pipelines, and barge unloading facilities are unlikely to be used after construction is complete, however, for the purposes of this analysis, the effects to species are considered permanent. • Subsurface segments of the tunnel/pipeline have no effects on biological resources.

Activity/Impact Mechanism	**Method of Impact Estimation**	**Key Assumptions for Purposes of Analysis**
Transmission line construction/ permanent removal of habitat	• GIS layer representing a conservative estimate of the total distance of the transmission line alignment was overlain on modeled habitat and critical habitat GIS layers. • The transmission line footprint assumes a 50-foot corridor to conservatively estimate a maximum take limit.	• Although a significant portion of the transmission lines will be removed upon project completion, due to the 14-year duration of the project, the impact to species habitat will be considered permanent. • Permanent effects to suitable habitat will be primarily from pole placement; tower placement; vegetation clearing around poles, towers, and under lines; and the creation of access roads for maintenance. • Vegetation clearing is expected to be needed in riparian areas. Grassland and cultivated lands are not expected to require vegetation clearing under transmission lines. • Existing roads will be used for access and maintenance whenever possible.
Geotechnical Exploration Activities/temporary removal of habitat	• Geotechnical exploration features within 20 meters of the construction footprint were assumed to overlap with existing construction features, no additional impact was assumed as these areas are already assumed to experience permanent habitat loss. • Exploration sites more than 20 meters outside the conveyance footprint but less than 1,000 meters were used to develop a geotechnical exploration zone (GEZ). • The GEZ was intersected with habitat models and critical habitat and results were multiplied by 21.6%, the estimated proportion of the GEZ that will experience a temporary effect based on estimates of access road length (.61 acres) and staging area size (.23 acres).	• Although a small, permanent effect will occur in the form of a cement-filled, drilling hole, all other effects are temporary. • Small, widely scattered, permanent effects from drilling in mostly disturbed locations are expected to be so small as to be insignificant. • Temporary impacts will be primarily from vehicles traveling off road, over land; equipment staging areas; and drilling or shallow-pit excavations. • Most or all of exploration sites will be within 1,000 feet of the conveyance facility footprint. • Shallow pits and any areas disturbed as a result of access, equipment staging, or associated activities will be returned to pre-project condition. • Activities are not expected to last more than 21 days at one site.

Table 4.B-2. Species Habitat that will be Avoided by Restoration Activities.

Species and Habitat	Tidal Restoration	Grassland Restoration for Giant Garter Snake	Nontidal Restoration for Giant Garter Snake	Riparian Restoration for Swainson's Hawk	Vernal Pool Complex Restoration	Channel Margin Enhancement
Swainson's hawk (nesting)		X	X	X	X	
Swainson's hawk (foraging)		X			-[1]	X
Giant garter snake		X	X		X	
California tiger salamander	X	X	X	X		X
Mason's lilaeopsis		X	X	X	X	

4.B.1.4 References

4.B.1.4.1 Written References

California Department of Water Resources. 2013. Draft Bay-Delta Conservation Plan. December.

Schamberger, M., A. H. Farmer, and J. W. Terrell. 1982. Habitat suitability index model: introduction. U.S. Fish and Wildlife Service. FWS/OBS-82/10. 2pp.

Witham, C. W., and G. A. Kareofelas. 1994. *Botanical Resources Inventory at Calhoun Cut Ecological Reserve Following California's Recent Drought*. Sacramento, CA: California Department of Fish and Game.

Zebell, R. and P. Fiedler. 1996. *Restoration and Recovery of Mason's Lilaeopsis: Phase II*. Final report to the California Department of Fish and Game Plant Conservation Program.

4.B.1.4.2 Personal Communications

Bradbury, Mike. DWR California WaterFix Permitting Lead, Program Manager II. Wildlife biologist, Swainson's hawk expert. February 24, 2016—Email to Brooke Jacobs at CDFW regarding Swainson's hawk nests.